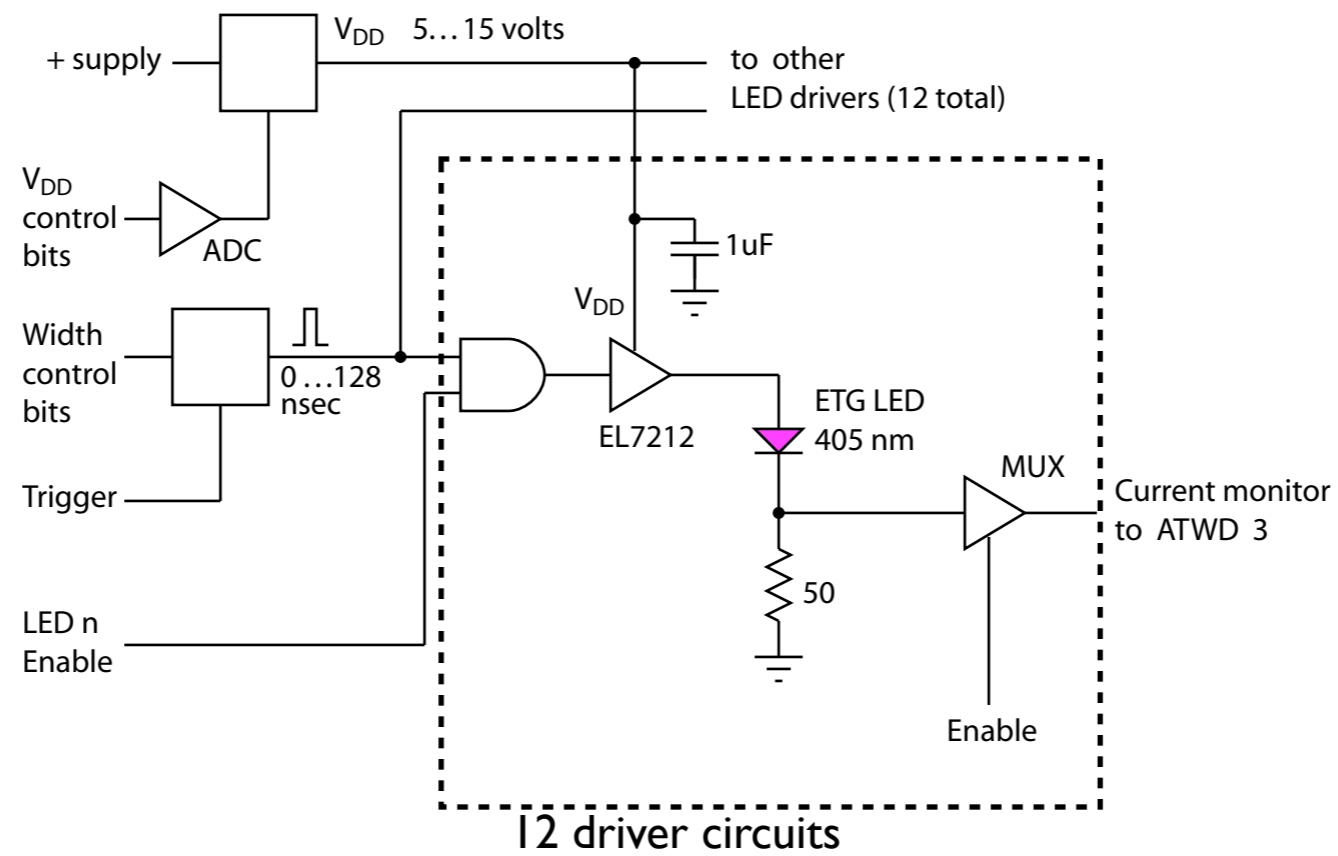


Flasher LED brightness measurements, issues

Chris Wendt

Flasher/Cascade Workshop, LBL July 2005

Flasher board simplified schematic



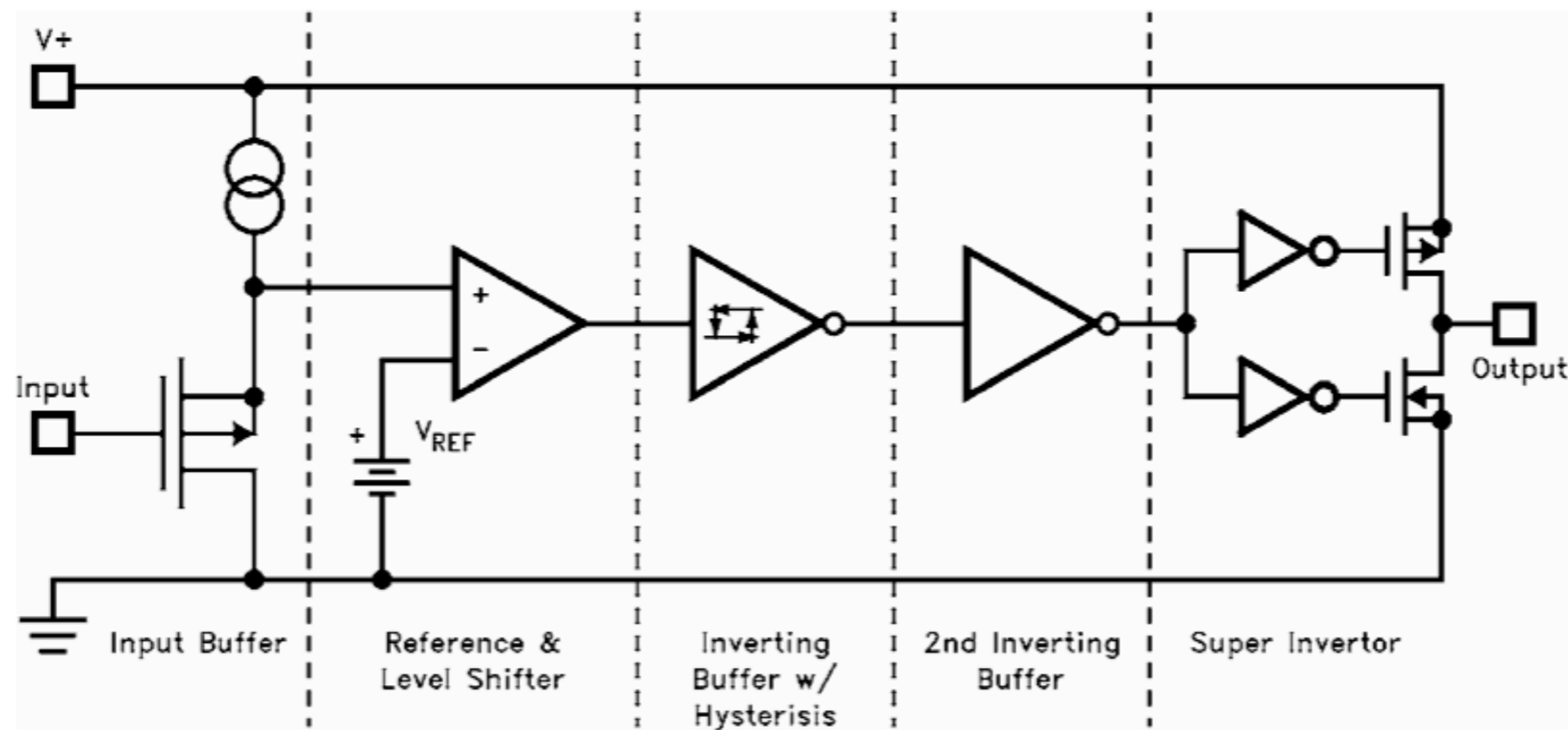
High Speed, Dual Channel Power MOSFET Drivers

élantec

The EL7202/EL7212/EL7222 ICs are matched dual-drivers that improve the operation of the industry standard

DS0026 clock drivers. The Elantec versions are very high speed drivers capable of delivering peak currents of 2.0 amps into highly capacitive loads. The high speed performance is achieved by means of a proprietary "Turbo-Driver" circuit that speeds up input stages by tapping the wider voltage swing at the output. Improved speed and drive capability are enhanced by matched rise and fall delay times. These matched delays maintain the integrity of input-to-output pulse-widths to reduce timing errors and clock skew problems. This improved performance is accompanied by a 10 fold reduction in supply currents over bipolar drivers, yet without the delay time problems commonly associated with CMOS devices. Dynamic switching losses are minimized with non-overlapped drive techniques.

LED Driver achieves rise time <4nsec for light pulse, as measured by fast photodiode (except for low driving voltage, more like 8 nsec)





ETG-5UV405-15

DESCRIPTION

SOURCE MATERIAL-----InGaN
 EMITTING COLOR-----Blue UV
 LENS TYPE-----WATER CLEAR

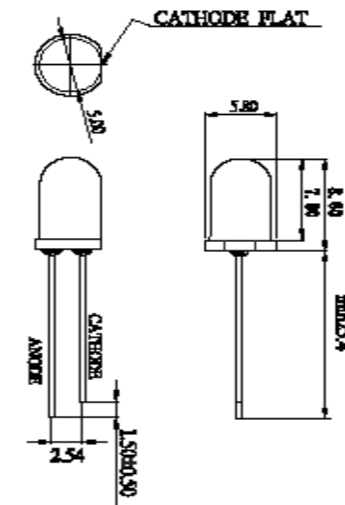
ABSOLUTE MAXIMUM RATING (Ta=25°C)

PULSE CURRENT-----100Ma
 AVERAGE FORWARD CURRENT-----30Ma
 DERATING FACTOR-----40mA/°C
 REVERSE VOLTAGE-----4.0V
 OPERATING TEMPERATURE----- -25°C TO +85°C
 STORAGE TEMPERATURE----- -25°C TO +100°
 LEAD SOLDERING TEMPERATURE-----260°C FOR 5 SEC.

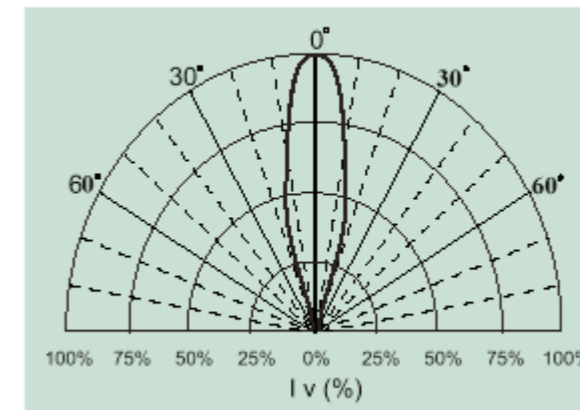
ELECTRICAL/OPTICAL CHARACTERISTICS (Ta=25°)

PARAMETER	CONDITION	SYMBOL	MIN	TYP	MAX	UNIT
PEAK WAVELENGTH	If=20mA	λ_D	400	405	410	nm
FORWARD VOLTAGE	If=20mA	VF		3.7	4.0	V
REVERSE CURRENT	VR=5V	Ir			10	μA
OUTPUT	If=20mA	Iv	10	12		mW
VIEWING ANGLE	If=20mA	2θ1/2		30		deg

Package Dimensions



Beam Pattern



CAUTION: EMITS ULTRAVIOLET RADIATION!!

- This device radiates intense ultraviolet (UV) light when operated.
- Exposure to UV radiation can be harmful to your health. Protect your eyes and skin during operation.
- Do not look directly at the device during operation. Exposure to UV light, even for a brief period, can damage your eyes.
- Do not operate the device unless you have had proper safety training and take appropriate precautions.
- Do not permit children or untrained personnel to operate the device.

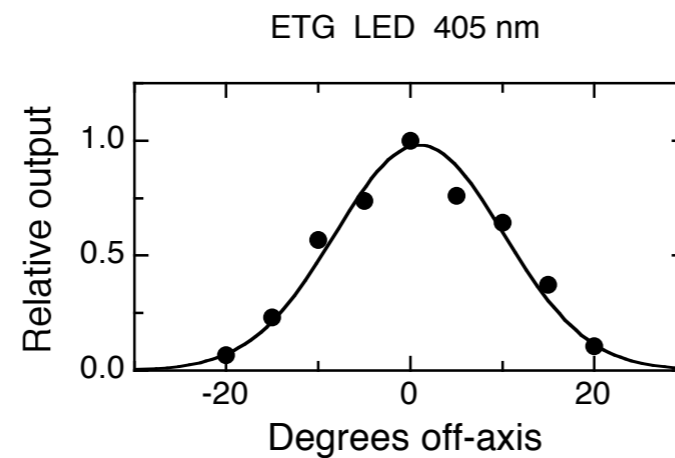
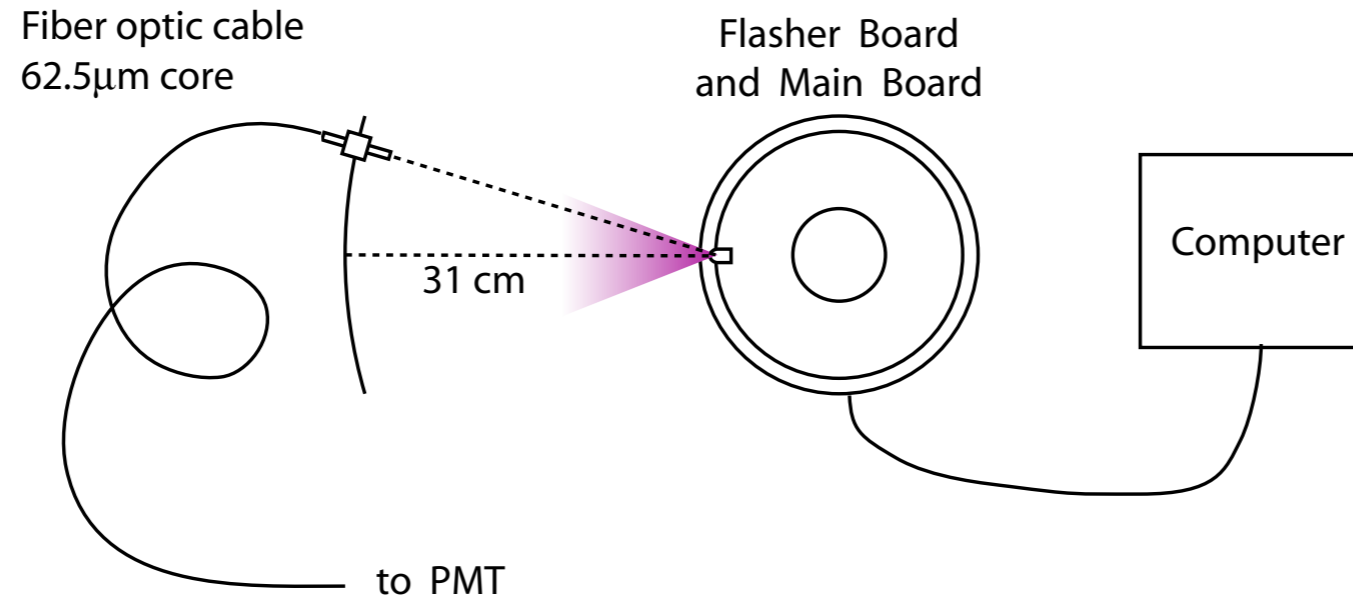
PRECAUTIONS:

These products are sensitive to static electricity; high standard of care must be fully taken when handling them. Particularly if an over-voltage that exceeds the Absolute maximum Rating of these products were applied, the overflow energy will cause damage to and possible result in destruction of these products. Buyer shall take absolute secure countermeasures against static electricity and surge when handling these products.

ETG, Inc., 6000 Venice Bl. 2nd Floor, Los Angeles, Calif. 90034, p. 323.937.5463, f. 310.268.1766

Web: <http://www.etgtech.com>, email sales@etgtech.com

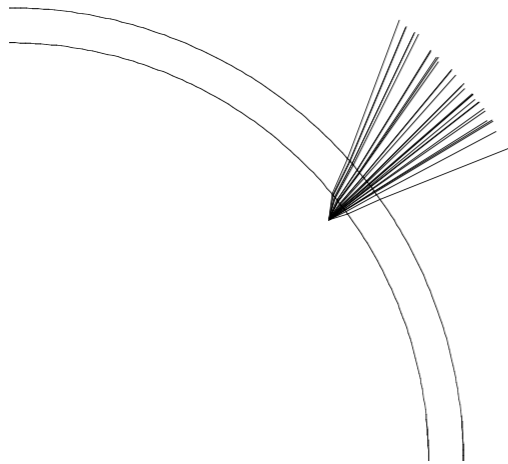
LED emission angular distribution



- Bare LEDs show $\sigma = 10\text{-}15$ degrees
Data sheet (ETG) says FWHM = 30 degrees $\rightarrow \sigma = 12.7$ degrees

LED emission angle - correct for air/glass/ice interface

- 10^6 rays simulated from each LED
Start with Gaussian; final pattern is very close to Gaussian



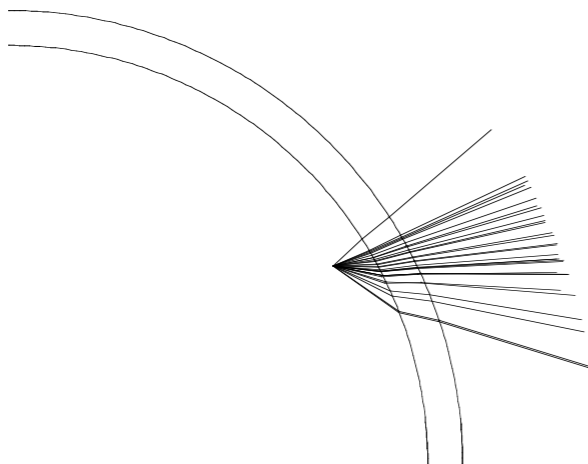
Upper LED

Bare LED

set at 51.6 degrees above horizontal plane
 $\sigma = 12.7$ degrees (nom.)

Emitted light

centered at 48 degrees
 $\sigma = 10$ degrees



Lower LED

Bare LED

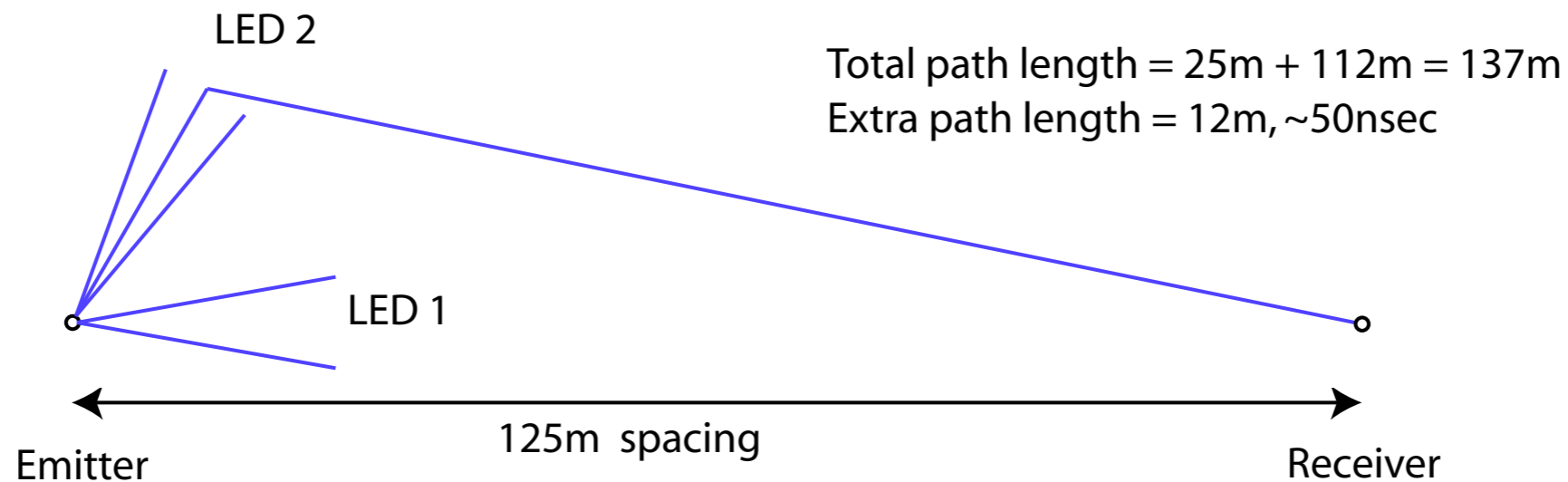
set at 10.7 degrees below horizontal plane
 $\sigma = 12.7$ degrees (nom.)

Emitted light

centered at 0 degrees
 $\sigma = 9$ degrees (polar angle)
 $\sigma = 10$ degrees (horizontal plane)

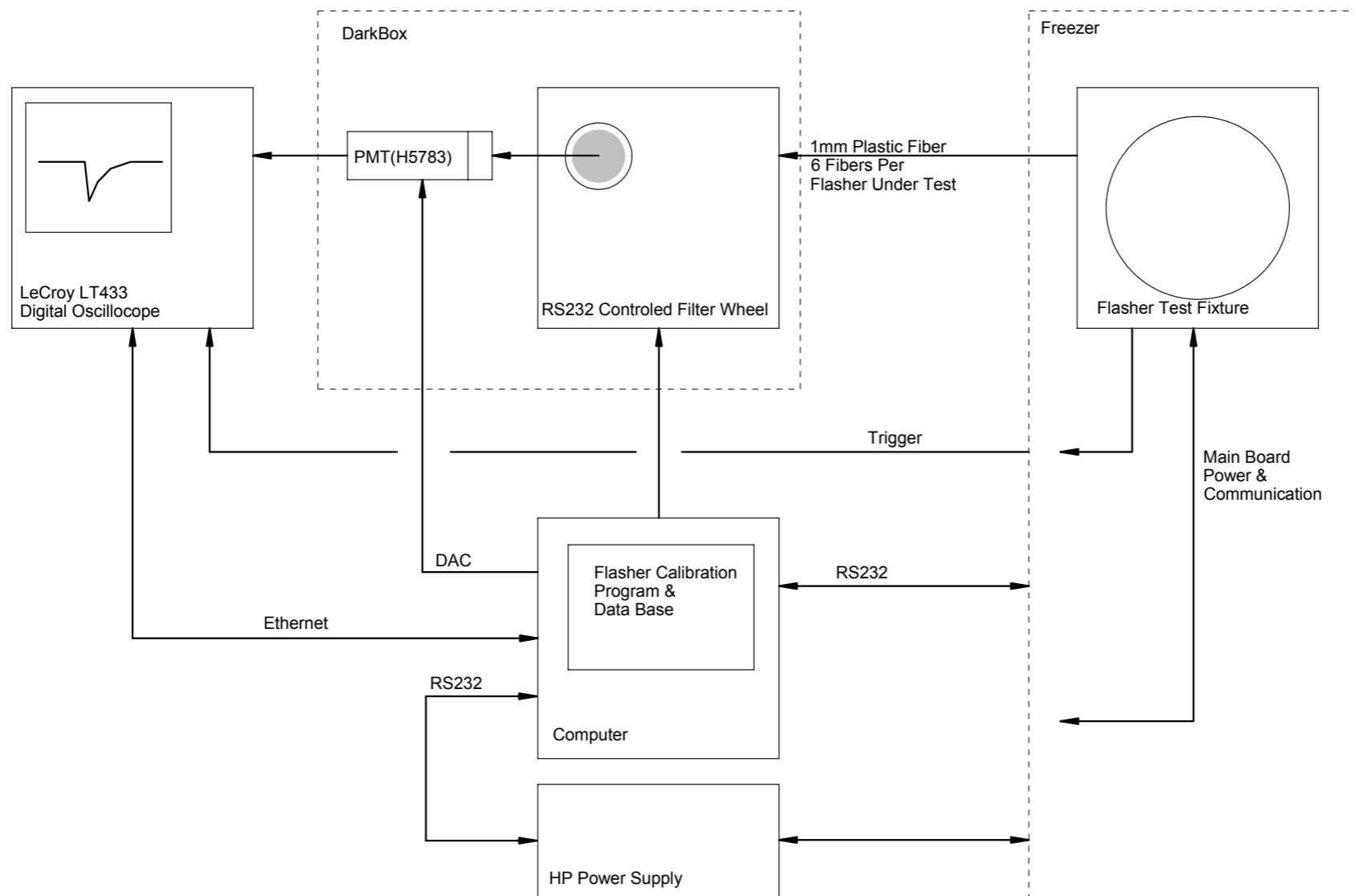
Observing orientation of DOMs in ice

- Flash each LED individually and observe waveform at neighboring string



- Once orientation is known:
 - do interstring calibrations with only nearest LED, correct for angle
 - turn on all LEDs, correct for angle plus relative intensities of LEDs

IceCube DOM Flasher Verification & Calibration Laboratory Setup



- Every flasher board is tested before integration into DOM
- All LEDs have total light output measured, at room temperature, relative to a “Gold standard” which needs to be absolutely calibrated
- Individual LEDs are within $\pm 25\%$ (required in 2004, almost true in 2005)
- Low temperature behavior has been characterized: not a big effect, very consistent from LED to LED. We don't measure light output in the DFL testing.

Total light output measurements

- Use similar setup as for angular emission pattern
- Aperture is defined by 62.5 micron optical fiber aimed at LED, about 30cm away
- Measure # photons with standard PMT, approximate efficiency 23%
- Integrate over all angles of the LED
- Result is roughly 6×10^9 photons per LED
- Lab measurements have been inconsistent at the 30% level, need to refine methods
- Output from DOM has not been measured (yet)